

I claim:

1. A spacer for use with a panel member used in a construction form, said spacer comprising:

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- (a) first and second rod members having first portions oriented generally in or towards a first direction, said first and second rod members being spaced apart in a second transverse direction that is orthogonal to said first direction and said first and second rods being in generally spaced, and generally parallel relation to each other, each of said first and second rod members having an end portion that is oriented at an angle to said first portions of said rod members, said angle being oriented toward a third longitudinal direction that is orthogonal to said first direction and said second direction;

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- (b) a first transverse rod member secured proximate to or at said end portion of said first and second rod members and extending generally in said second transverse direction between said first and second rod members;

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- (c) a second transverse rod member secured to said end portions of each of said first and second rod members, said second transverse rod member being spaced in said first and third directions from said first transverse rod member, and said second transverse rod member extending generally in said second transverse direction between said first and second rod members; and

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- (d) said first and second vertical rod members, and said first and second transverse rod members defining and providing there between a retaining cell, for receiving there through and retaining an elongated reinforcement member oriented generally in one or both of said first and third directions.

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2. A spacer as claimed in claim 1, wherein said first direction is substantially vertical.
3. A spacer as claimed in claim 2, wherein said first and second rod members have end portions that are oriented at substantially the same angle to said first portions of said first and second rod members.
4. A spacer as claimed in claim 3, wherein said same angle is between 20 and 40 degrees measured from said first direction.
5. A spacer as claimed in claim 1, wherein said apparatus for securing said spacer to said panel member comprises one of said first and second transverse rods having an end portion adapted to be secured to a panel connector.
6. A spacer as claimed in claim 1, wherein each of said first and second rod members has a second end portion opposite to said first end portion, each said first and second end portions being oriented at a first and second angle respectively to said first portions of said first and second rod members, said first and second angles both being oriented toward said third longitudinal direction that is orthogonal to said first direction and said second direction and wherein said spacer further comprises:
 - (a) a third transverse rod member secured proximate to or at said second end portion of said first and second rod members and extending generally in said second transverse direction between said first and second rod members;
 - (b) a fourth transverse rod member secured to said second end portions of each of said first and second rod members, said fourth transverse rod member being spaced in said first and third directions from said third transverse rod member, and said fourth transverse rod member extending

generally in said second transverse direction between said first and second rod members;

said first and second rod members, and said third and fourth transverse rod members configured to define and provide there between a second retaining cell, for receiving there through and retaining a generally vertically oriented reinforcement member.

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- 10 7. A spacer as claimed in claim 6, wherein said first and second retaining cells are substantially aligned in said second and third directions and spaced in said first direction to permit a reinforcement member generally oriented in said first direction to be retained in both said first and second retaining cells.
- 15 8. A spacer as claimed in claim 5, said first and second angles are supplementary angles.
9. A spacer as claimed in claim 8 wherein said first direction is substantially vertical.
- 20 10. A spacer as claimed in claim 9, wherein said first and second rod members have end portions that are each oriented at substantially the same angle to said first portions of said first and second rod members.
- 25 11. A spacer as claimed in claim 8, wherein said apparatus for securing said spacers to said panel member comprises one of said first and second transverse rods of each said first and second spacer having an end portion adapted to be secured to a panel connector.

12. A combination of first and second spacers for use in combination with a panel member used in a construction form for a wall, each of said first and second spacers comprising:

5 (a) first and second rod members having first portions oriented generally in or towards a first direction, said first and second rod members being spaced apart in a second transverse direction that is orthogonal to said first direction and said first and second rods being in generally spaced, and generally parallel relation to each other, each of said first and second rod
10 members having an end portion that is oriented at an angle to said first portions of said rod members, said angle being oriented toward a third longitudinal direction that is orthogonal to said first direction and said second direction;

15 (b) a first transverse rod member secured proximate to or at said end portion of said first and second rod members and extending generally in said second transverse direction between said first and second rod members;

20 (c) a second transverse rod member secured to said end portions of each of said first and second rod members, said second transverse rod member being spaced in said first and third directions from said first transverse rod member, and said second transverse rod member extending generally in said second transverse direction between said first and second rod members; and

25 (d) said first and second vertical rod members, and said first and second transverse rod members defining and providing therebetween a retaining cell, for receiving therethrough and retaining an elongated reinforcement member oriented generally in one or both of said first and third directions;
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said retaining cell of said first spacer being spaced in said first direction from said retaining cell of said second spacer, and said retaining cell of said first spacer being substantially aligned within said second and third directions with said retaining cell of said second spacer to permit said reinforcement member to be held in a direction generally oriented to said first direction, by said first and second retaining cells.

13. A panel unit comprising:

(a) at least one upstanding and longitudinally oriented panel member;

(b) a spacer mounted to said panel member and said spacer comprising

(i) first and second rod members having first portions oriented generally in or towards a first direction, said first and second rod members being spaced apart in a second transverse direction that is orthogonal to said first direction and said first and second rods being in generally spaced, and generally parallel relation to each other, each of said first and second rod members having an end portion that is oriented at an angle to said first portions of said rod members, said angle being oriented toward a third longitudinal direction that is orthogonal to said first direction and said second direction;

(ii) a first transverse rod member secured proximate to or at said end portion of said first and second rod members and extending generally in said second transverse direction between said first and second rod members;

(iii) a second transverse rod member secured to said end portions of each of said first and second rod members, said second

transverse rod member being spaced in said first and third
directions from said first transverse rod member, and said second
transverse rod member extending generally in said second
transverse direction between said first and second rod members;
and

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said first and second vertical rod members, and said first and second transverse
rod members defining and providing there between a retaining cell, for
receiving there through and retaining an elongated reinforcement member
oriented generally in one or both of said first and third directions.

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14. A unit as claimed in claim 13 further comprising a securing mechanism for
securely mounting said spacer to said panel member.

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15. A unit as claimed in claim 14, wherein said securing mechanism comprises one
of said first and second transverse rods having an end portion adapted to be
secured to a panel connector.

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16. A unit as claimed in claim 13, wherein said panel member has a plurality of
perforations extending between an inner and an outer surface and said one of
said first and second transverse rod members has an end extending into one of
said perforations for securing said spacer to said panel connector.

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17. A panel unit as claimed in claim 13, wherein said first and second rod members
each has an end portion that is oriented at substantially the same angle to said
medial portion of said first and second vertical rod member.

18. A panel unit as claimed in claim 13, wherein said panel member is made from a
foamed plastic material.

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19. A panel unit as claimed in claim 13, wherein said spacer has a third rod member oriented generally in said first direction, said first, second and third rod members being in generally spaced, parallel relation to each other, said first and second transverse rod members extending across said first, second and third vertical rod members, said third vertical rod member being positioned in abutting adjacent relation to an inner surface of said panel member, whereby said first panel member is held between said connector and said third vertical rod member.

20. A panel unit as claimed in claim 13 further comprising a second panel member arranged in a spaced generally opposite parallel relation to said first panel member and wherein said spacer is mounted to and between said first panel member and said second panel member.

21. A connector assembly for use in securing a panel member to a transverse tie rod, said connector assembly comprising:

(a) a cap member having a flange cap portion and a shaft portion, said shaft portion with an end having an opening adapted to be interconnected to an end portion of a tie rod; and,

(b) a bushing member having a flange portion and an axially aligned shaft portion with an end opposite to said flange portion, said bushing member having a continuous cavity formed in and passing through said flange portion and said shaft portion,

said shaft portion of said cap member being receivable axially into said continuous cavity of said bushing member through said flange portion toward said end of said shaft portion so as to be able to engage said end of said tie rod extending through said end of said bushing member into said continuous cavity, said shaft portion of said cap member also engaging an abutment in said

continuous cavity of said bushing member so to limit the extent of axial movement of said shaft portion of said cap member relative to said bushing member toward said end of said shaft portion of said bushing member;

5 whereby a panel member can be held between said flange portion of said cap member and said flange portion of said bushing member.

22. A connector assembly as claimed in claim 21, wherein said cap member can be axially moved toward transverse rod member, such that a panel member can be
10 compressed between said flange portion of said cap member and said flange portion of said bushing member to provide a rigid connection between said connector assembly, said panel member and said tie rod.

23. A connector assembly as claimed in claim 22, wherein said cap member is made
15 from a plastic material.

24. A connector assembly for use in securing a panel member to a transverse tie rod, said connector assembly comprising:

20 (a) a cap member having a flange cap portion and a shaft portion, said shaft portion with an end having an opening adapted to be interconnected to an end portion of a tie rod; and

(b) a bushing member having a flange portion and an axially aligned shaft
25 portion with an end opposite to said flange portion, said bushing member having a continuous cavity formed in and passing through said flange portion and said shaft portion;

said shaft portion of said cap member being receivable axially into said
30 continuous cavity of said bushing member through said flange portion toward said end of said shaft portion for releasable engagement with said end of said tie

rod extending through said end of said bushing member into said continuous cavity; and

5 said flange portion of said bushing having at least one aperture passing there through, said aperture and having an opening for permitting the fluid communication of flowable concrete into said aperture, said aperture being configured such that when concrete flows into and hardens in said aperture, said hardened concrete in said aperture which is integrally connected to hardened concrete outside of said aperture provides an anchoring device to hold said
10 bushing member in said hardened concrete.

25. An assembly as claimed in claim 24, wherein said at least one aperture in said flange of said bushing member is configured in a generally inwardly directed generally conical shape.

- 15 26. A connector for use in securing a panel member to a tie rod, said connector having a flange cap portion and a shaft portion, said shaft portion having an end having an opening into a cavity, said tie rod having a plurality of separate circular teeth spaced from each other, said teeth having an outer diameter that is
20 larger than the inner diameter of said inner wall of said cavity in said shaft, said shaft portion being made of a material that will elastically deform to receive said teeth of said end portion of said tie rod, such that when said tie rod end is forced through said opening into said cavity, said inner wall will bind with said teeth to provide a connection that resists axial loading of said connector tending
25 to pull said rod out of said cavity of said shaft.

27. A connector assembly as claimed in claim 26, wherein said shaft portion of said connector is made from polypropylene.

28. A connector for use in securing a panel member to a transverse tie rod, said connector comprising:

5 (a) a cap flange portion and a shaft portion, said shaft portion with an end having an opening adapted to be interconnected to a transverse tie rod, said tie rod having an end portion; and,

(b) a cutting element positioned beneath an under surface of said cap flange portion;

10 whereby when said connector member is rotated to provide a connection with said tie rod, and said connector member is axially drawn toward said tie rod, a panel member can be held between said flange portion of said cap member and said flange portion of said spacer member, and said cutting element will form a
15 recess in an outer surface of said panel member for receiving said cap flange portion.

29. A connector as claimed in claim 27 wherein said cap flange portion and said shaft portion are made from a rigid plastic material.

30. A connector assembly for use in securing a panel member to a tie rod, said connector assembly comprising:

25 (a) a cap member having a flange cap portion and a shaft portion, said shaft portion with an end having an opening adapted to be interconnected to an end portion of a tie rod; and

(b) a bushing member having a flange portion and an axially aligned shaft
30 portion with an end opposite to said flange portion, said bushing member

having a continuous cavity formed in and passing through said flange portion and said shaft portion;

said shaft portion of said cap member being receivable axially into said continuous cavity of said bushing member through said flange portion toward said end of said shaft portion for releasable engagement with said end of said tie rod extending through said end of said bushing member into said continuous cavity and said end of said bushing member having guide members depending inwardly to guide said end of said tie rod into axial alignment with said opening in said cap portion.

31. A method of forming a concrete wall comprising the steps:

A. providing a panel member as part of a form work;

B. interconnecting a connector assembly to a tie member through said panel member, said connector assembly comprising:

(i) a cap member having a flange cap portion and a shaft portion, said shaft portion with an end having an opening adapted to be interconnected to an end portion of a tie rod;

(ii) a bushing member having a flange portion and an axially aligned shaft portion with an end opposite to said flange portion, said bushing member having a continuous cavity formed in and passing through said flange portion and said shaft portion;

said step of connecting comprising (a) positioning said bushing member with said flange portion proximate an inner surface of said panel member and moving said end portion of said tie rod through said cavity in said bushing member and (b) positioning said cap portion of said cap member

proximate an outer surface of said panel member and moving said shaft portion of said cap member through said panel member and axially into said continuous cavity of said bushing member through said flange portion toward said end of said shaft portion for releasable engagement with said end of said tie rod; (c) pouring the concrete into said form work and allowing said concrete to harden; and, (d) dis-engaging said cap member from said end of said tie rod; (e) removing said cap member.

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32. A method as claimed in claim 30 further comprising after step (e), the step (f) of removing said panel member.

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33. A method as claimed in claim 31 further comprising after the step (f) of filling in the outer opening to the continuous cavity in the bushing member.

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34. A method of providing form work with a panel unit, said panel unit comprising an upstanding panel member and at least one tie rod having an end portion, said method comprising employing a connector to engage said end of said tie rod through said panel, said connector comprising:

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(a) a cap flange portion and a shaft portion, said shaft portion with an end having an opening adapted to be interconnected to said tie rod;

(b) a cutting element positioned beneath an under surface of said cap flange portion;

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said method including the step of rotating the connector to provide a connection with said tie rod, and wherein said connector is axially drawn onto said tie rod, said panel member is held between said flange portion of said cap member and said flange portion of said spacer member, and said cutting element will form a recess in an outer surface of said panel member for receiving said cap flange portion.

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35. A panel unit for use as part of a concrete form for a reinforced concrete wall, said panel unit comprising:

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(a) a pair of spaced apart panels both oriented in or towards a first longitudinal direction; and,

(b) a spacer comprising:

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(i) first and second rod members oriented generally in or towards a second direction that is orthogonal to said first direction, said first and second rod members being in generally spaced, parallel and planar relation to each other;

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(ii) a transverse rod member oriented generally in or toward a third transverse direction that is orthogonal to said first direction and said second direction, said transverse rod member being secured to and extending between said first and second panels, said transverse rod member having a first end and an opposite second end adapted for securing said reinforcement unit to a panel connector mounted to each said first and second panel members, respectively, so as to provide at least one transverse tie rod member between said first and second panels; and

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(c) a form liner panel positioned between said first and second panels proximate an inner surface of said first panel.

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36. A panel unit as claimed in claim 35 wherein said form liner panel is mounted in close proximity to said inner surface of said first panel with said connector

member at said first panel being a releasable connector, such that said connector can be released to assist in facilitating removal of said first panel and said form liner panel

5 37. A panel unit as claimed in claim 35 wherein at least one of said panels is made from a foamed plastic material.

38. A panel unit as claimed in claim 35 wherein said form liner panel has a contoured inwardly directed surface.

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39. A panel unit as claimed in claim 35 wherein said connector member at said first panel comprises at least one connector assembly for use in securing said first and second panel members in a rigid or semi-rigid position relative to said transverse tie rod, said at least one connector assembly comprising:

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(a) a cap member having a flange cap portion positioned proximate an outer surface of said first panel member and a shaft portion, said shaft portion having an end having an opening to a cavity, said shaft portion passing from proximate an outer surface of said first panel through an opening in said first panel toward an inner surface of said first panel, and said shaft portion being interconnected to a first end portion of a transverse tie rod;

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(b) a bushing member having a flange portion and an axially aligned shaft portion with an end opposite to said flange portion, said bushing member having a continuous cavity formed in and passing through said flange portion and said shaft portion;

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said shaft portion of said cap member being receivable axially through said first panel and said form liner panel into said continuous cavity of said bushing member for releasable engagement with said end of said tie rod in said cavity in

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said shaft, said tie rod end extending through said said bushing member into said continuous cavity.

- 5 40. A panel unit as claimed in claim 39 wherein said bushing member has a portion in abutment with said inner surface of said form liner panel, and said flange portion of said cap member being in abutment with said first panel proximate said outer surface of said first panel.
- 10 41. A panel unit as claimed in claim 40 wherein said form panel liner is held between said inner surface of said first panel member and said bushing member.
- 15 42. A panel unit as claimed in claim 39 wherein said cap member has its shaft portion receivable axially into said continuous cavity at said flange portion of said bushing and extends toward said end of said bushing.
- 20 43. A panel unit as claimed in claim 39 wherein said cap member can be released from said end of said tie rod, such that said cap member can be removed from inside said continuous cavity of said bushing.
- 25 44. A panel unit as claimed in claim 39 further comprising a form liner panel that is contoured on its inner surface.
- 30 45. A panel unit as claimed in claim 39 wherein said form liner has at least one aperture there through and said shaft portion of said cap member passes from a first outer side of said form liner through said aperture in said form liner to a second inner side of said form liner to connected to a first end portion of said transverse tie rod.
46. A panel unit as claimed in claim 39 further comprising a first abutting unit positioned between said bushing member and said second panel member, whereby when said cap member is drawn axially toward said tie rod, said first

panel member is held between said flange portion of said cap member and said form panel liner, said bushing member is held between said inner surface of said form liner panel and said first abutting unit.

- 5 47. A panel unit as claimed in claim 46 further comprising a second connector secured to a second opposite end of said tie rod, through said second panel, said second connector having a flange portion proximate an outer surface of said second panel and a shaft portion passing through said second panel member to engage said opposite end of said tie rod;

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one of said flange portion and said end of said shaft portion of said bushing of said first connector being in abutment with said inner side of said form liner, and the other of said flange portion and said end of said shaft portion of said bushing being in abutment with said first abutting unit, and said flange portion of said cap member being in abutment with said first panel proximate said outer surface of said first panel, said tie rod having attached thereto a second abutting unit in abutment with an inner surface of said second panel to resist transverse movement of said second panel toward said spacer member,

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whereby when said cap member is drawn axially toward said tie rod, said first first panel member is held between said flange portion of said cap member of said first connector and said form liner, and said form liner is held between said one of said end of said shaft and said flange portion of said bushing, and said inner surface of said first panel; and said bushing is held between said form liner and said first abutting unit, and said second panel is held between said second abutting unit and said flange portion of said second connector member.

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48. A panel unit as claimed in claim 47 wherein said cap member has its shaft portion receivable axially into said continuous cavity at said end of said shaft portion of said bushing member and extends toward said flange portion of said bushing member.

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49. A connector as claimed in claim 48 wherein said cap flange portion and said shaft portion are made from a rigid plastic material.

5 50. A panel unit as claimed in claim 49 wherein at least one of said panels is made from a foamed plastic material.

51. A panel unit as claimed in claim 46 wherein said first abutting unit comprises a third generally vertically and longitudinally oriented panel, spaced in generally
10 parallel relation to said first and second panels, said tie rod member passing through said third panel.

52. A panel unit as claimed in claim 51 wherein said third panel is made from a foamed plastic material.

15 53. A panel unit as claimed in claim 51 wherein said third panel has a first side in abutment with said bushing member and a second side in abutment with a vertical rod member that forms part of said spacer and is secured to said transverse tie rod.

20 54. A panel unit as claimed in claim 43 wherein said cap member, said first panel and said form liner are removable from said panel unit, when concrete has been poured and hardened in a form space between said first panel and said second panel.

25 55. A panel unit as claimed in claim 39 wherein said cap member, said first panel and said form liner are removable from said panel unit, when concrete has been poured and hardened in form spaces between said first panel and said third panel, and between said third panel and said second panel.

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56. A panel unit as claimed in claim 55 wherein said cap member can be released from said end of said tie rod, such that said cap member can be removed from inside said continuous cavity of said bushing member.

5 57. A panel unit for use as part of a concrete form for a reinforced concrete wall, said panel unit comprising:

- 10 (a) first and second generally upstanding longitudinally oriented panels arranged with each having a surface in an adjacent position to each other, said surface of said first panel being oriented longitudinally at an angle to said surface of said second panel;
- 15 (b) a connector associated with each of said first and second panels, each said connector having a flange portion positioned proximate said surface of said first panel and said second panel, each said connector having a shaft portion extending from said flange portion and passing through its respective panel and being secured to a tie rod member;
- 20 (c) an angled plate member having a first plate portion positioned against a surface of said first panel, and a second plate portion being oriented substantially at said angle to said first plate portion and being positioned against a corresponding adjacent surface of said second panel, each of said plate portions having an opening or slot for receiving therein said shaft portion of the respective connector or said tie rod member, each respective
- 25 plate portion held in a substantially fixed position relative to their respective first and second panels, to assist in holding said first and second panel in a substantially stationary position relative to each other.

30 58. A panel unit as claimed in claim 55 wherein said angle is approximately 90 degrees.

59. A panel unit as claimed in claim 55 wherein said plate member is made of a plastic.

60. A panel unit as claimed in claim 55 wherein said plate member is made of a metal.

61. A panel unit for use as part of a concrete form for a reinforced concrete wall, said panel unit comprising:

(a) pair of spaced apart generally vertically and longitudinally oriented panels defining a form space there between, said first panel having a longitudinally extending gap between a panel upper portion and a panel lower portion;

(b) a ledge form unit comprising at least one ledge form member, providing a form for a ledge to extend said form space through said gap for providing a form for a ledge portion;

(c) a spacer comprising first and second transverse tie rod members secured to and extending between said first and second panels and being in spaced apart relation to each other, said first and second transverse rod members having a first end and an opposite second end each being adapted for securing said first and transverse tie rods to a panel connector member having an outer flange positioned at an outer surface of said first and second panel members, respectively, so as to provide transverse tie rod members between said first and second panels, a panel connector member of said first tie rod being mounted to said upper portion of said first panel, and a panel connector connected to second tie rod being mounted to said lower portion of said first panel said ; and

(d) a plate member having a first plate portion positioned against a surface of said upper portion of said first panel, and having a second plate portion positioned against a surface of said lower portion of a surface of said first panel, each of said first and second plate portions having a slot or opening for receiving therein a shaft portion of the respective connector or said tie rod member, to hold said plate member in a substantially fixed position relative to upper and lower portion, to assist in holding said upper and lower panel portions in a substantially stationary position relative to each other, said plate member also comprising a third plate portion extending from said first plate portion over said gap to second plate portion, said third plate portion acting as a support member for said ledge form member.

62. A panel unit for use as part of a concrete form for a reinforced concrete wall, said panel unit comprising:

(a) a pair of spaced apart longitudinally oriented foamed plastic panels defining a form space therebetween;

(b) a spacer comprising at least one transverse tie rod member secured to and extending between said first and second panels, said transverse rod member having a first end and an opposite second end each being adapted for securing said transverse tie rod to a panel connector member, at least one of said panel connectors being releasable from said tie rod;

wherein said first panel member has at least one inner surface treated with a material having enhanced non-adhesive properties, such that the inner surface will tend not to bond extensively to said hardening or hardened concrete, and wherein said at least one connector can be released and said connector and said first panel removed.

63. A panel unit as claimed in claim 62, wherein said material is a suitable plastic that is laminated onto said inner surface of said first panel member.

5 64. A method of forming a reinforced concrete wall with a panel unit as part of a form work, said panel unit comprising:

(a) a pair of spaced apart longitudinally oriented foamed plastic panels defining a form space there between;

10 (b) a spacer comprising at least one transverse tie rod member secured to and extending between said first and second panels, said transverse rod member having a first end and an opposite second end to a panel connector to secure said panels with said tie rod, at least one of said panel connectors being releasable from said tie rod;

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(c) at least one reinforcement member positioned in said form space

20 wherein said first panel member has at least one inner surface treated with a material having enhanced non-adhesive properties, such that the inner surface will tend not to bond extensively to said hardened concrete;

said method comprising the steps of:

- 25 (i) arranging said panel unit as part of said formwork;
- (ii) filling said form space with unhardened concrete and allowing said unhardened concrete to sufficiently harden to permit removal of said formwork;
- (iii) releasing said releasable panel connector from securement to said tie rod;
- 30 (iv) removing said first panel member from said formwork.

65. A panel unit comprising:

(a) At least one upstanding panel member oriented in a longitudinal direction;

5 (b) a spacer mounted to said panel member, said spacer comprising:

a rod member and a reinforcement bar member oriented generally in or towards
a first direction, said rod member and said reinforcement bar member being
spaced apart in a second transverse direction that is orthogonal to said first
10 direction and said rod member and said reinforcement bar member being in
generally spaced, planar and generally parallel relation to each other;

a transverse rod member secured to and extending generally in said second
direction between said rod member and said reinforcement bar member;

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such that said rod member, said reinforcement bar member and said transverse
rod member form a substantially planar, rigid geometrically stable grid.